A Review on middle atmospheric structure, dynamics and coupling: Highlights from 25 years Indian MST radar and complimentary observations

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Abstract

The genesis for Indian MST radar came from the Indian Middle Atmospheric Programme (IMAP) to study the middle atmospheric dynamics and its underlying processes. During early 1990's VHF radar operating at 53 MHz has been setup at Gadanki (13.5^{o}N, 79.2^{o}E), India, which started operating initially in the stratospheric and tropospheric (ST) mode. It is upgraded to Mesosphere-Stratosphere-Troposphere (MST) mode in 1993. Since then, it served various scientific experiments not only from the India but also with international collaboration. Numerous focused campaigns that have national and international importance were conducted. Using this unique data in last 25 years, several stimulating results has been reported covering wide range of topics that includes gravity wave characteristics, tides, planetary waves, oscillations, tropopause dynamics and stratosphere-troposphere exchange processes, monsoon dynamics and circulations, mesospheric structure and dynamics, vertical and lateral coupling and the long-term trends. In present talk, we will highlight the unique results obtained using long-term observations of Indian MST radar and complimentary techniques covering complete middle atmosphere. Unique results includes quantification of the momentum carried by the high frequency waves generated in the troposphere up to the mesosphere, demarcating the complete tropical tropopause layer using MST radar observations alone, indication for the strengthening of the topical easterly jet in the recent decade, unusual behavior of the Hardly circulation during drought and El Nino years, revelation of the mechanisms for the occurrence of mesospheric echoes at the tropical latitudes, quantification of the turbulence, evidence for the role of anthropogenic changes on the dynamics of the mesosphere.

Key words: Indian MST radar, middle atmosphere, waves, tropopause, mesosphere